



ESC

European Society  
of Cardiology

# May Measurement Month 2019: an analysis of blood pressure screening results from China

Xin Chen<sup>1</sup>, Chang-Yuan Liu<sup>1</sup>, Li-Ying Xu<sup>2</sup>, Hong-Yu Wang<sup>3</sup>, Min Liu<sup>4</sup>,  
Yu-Qing Zhang<sup>5</sup>, Xin-Hua Yin<sup>6</sup>, Xiao-Long Wang<sup>7</sup>, Jing Yu<sup>8</sup>, Wei-Hua Li<sup>9</sup>,  
Thomas Beaney<sup>10,11</sup>, Xin Xia<sup>10</sup>, Neil R. Poulter<sup>10</sup>, Yan Li<sup>1</sup>, and  
Ji-Guang Wang<sup>1\*</sup>

<sup>1</sup>Department of Hypertension, The Shanghai Institute of Hypertension, Ruijin Hospital, Shanghai Jiaotong University School of Medicine, Ruijin 2nd Road 197, Shanghai 200025, China

<sup>2</sup>Department of Cardiology, Datong Fourth People's Hospital, No.16, Yongtai South Road, Pingcheng District, Datong 037008, Shanxi Province, China

<sup>3</sup>Department of Cardiology, Second Hospital of Shanxi Medical University, No.382, Wuyi Road, Taiyuan 030001, Shanxi Province, China

<sup>4</sup>Department of Hypertension, Henan Provincial People's Hospital, No.7, Weiwu Road, Zhengzhou 450003, Henan Province, China

<sup>5</sup>Department of Hypertension, Fuwai Hospital, 167 Beilishi Road, Xicheng District, Beijing 100037, China

<sup>6</sup>Department of Cardiology, The First Affiliated Hospital of Harbin Medical University, 23 Post Street, Nangang District, Harbin 150081, Heilongjiang Province, China

<sup>7</sup>Department of Cardiology, People's Hospital of Hongsibao District, No. 004, Wenhua Street, Hongsibao District, Wuzhong 751900, Ningxia Province, China

<sup>8</sup>Department of Hypertension, Lanzhou University Second Hospital, Cuiyingmen 82, Chengguan District, Lanzhou 730030, Gansu Province, China

<sup>9</sup>Department of Cardiology, The First Affiliated Hospital of Xiamen University, Zhenhai Road 55, Siming District, Xiamen 361003, Fujian Province, China

<sup>10</sup>Imperial Clinical Trials Unit, Imperial College London, Stadium House, 68 Wood Lane, London W12 7RH, UK; and

<sup>11</sup>Department of Primary Care and Public Health, Imperial College London, St Dunstan's Road, London W6 8RP, UK

## KEYWORDS

Hypertension;  
Blood pressure;  
Screening;  
Treatment;  
Control;  
China

To report the blood pressure (BP) data obtained in the May Measurement Month (MMM) 2019 in China. Study participants were recruited if  $\geq 18$  years of age and had ideally not had their BP measured for  $\geq 1$  year. BP was measured three times consecutively with a 1-min interval in the sitting position, using a validated electronic BP monitor. Trained volunteer investigators administered a questionnaire to collect information on lifestyle, medical history, and use of medications. The measurement was performed in 238 387 participants in 250 sites across 31 China provinces. The majority of screening took place in hospitals or clinics (78.7%), with 17.1% in outdoor public areas and 4.2% in other settings. The study participants included 127 853 women (53.6%) and had a mean ( $\pm$ SD) age of  $48.9 \pm 16.2$  years. The mean (of readings two and three) systolic/diastolic BP was 121.8/73.8 mmHg. In all hypertensive patients ( $n = 66\ 181$ , 27.8%), the awareness, treatment, and control rates of hypertension were 51.5%, 48.4%, and 29.1%, respectively. Linear regression models showed differences in systolic and diastolic BP according to sex and age and several other

\*Corresponding author. Tel: +86 21 6437 0045 (Ext 610911), Fax: +86 21 6466 2193, Email: jiguangwang@aim.com

major characteristics, such as previous stroke, myocardial infarction, and diabetes mellitus, antihypertensive medication use and known hypertension, previous hypertension in pregnancy and current pregnancy, alcohol intake and current smoking, and body mass index. The MMM 2019 campaign has been successful in measuring BP in a large number of participants in China.

## Introduction

As one of the Chinese nationwide initiatives for improving management of hypertension, the May Measurement Month (MMM) project has been successfully carried out for three successive years since 2017.<sup>1,2</sup> The measurement activities in hundreds of sites in almost all Chinese provinces helped tens of thousands of people to know their blood pressure (BP) and via the public media may have also influenced many others to understand the importance of BP measurement and increased awareness. The data obtained from the project over the last 2 years showed that the proportion of hypertension was  $\sim 1/4$  of the adult Chinese population, and the awareness, treatment, and control of hypertension were about 60.0%, 40.0%, and 25.0% respectively. If the data are compared with the most recent Chinese nationwide BP survey,<sup>3</sup> the situation in controlling hypertension in China is improving gradually. In 2019, the MMM project continued in China. In the present analysis, we report the BP data obtained in the MMM 2019 project in China.

## Methods

The MMM China project strictly followed the international MMM 2019 protocol, which had been previously described in detail elsewhere.<sup>2,4</sup> The project was conducted in 250 sites across 31 China provinces from May to September 2019. Measurement sites were mostly inside hospitals or community health centres, but usually located in a public area instead of doctors' offices for routine clinical service. All investigators received standard training before the study started, including standardized BP measurement techniques. The study protocol was approved by the Ethics Committee of Ruijin Hospital, Shanghai Jiaotong University School of Medicine, Shanghai, China. All participants provided written informed consent.

Eligible participants were volunteer adults aged 18 years or over, who had ideally not taken BP measurement in the previous year. BP was measured three times consecutively with an 1-min interval in the sitting position after at least 5 min rest, using a validated automatic BP monitor (HEM-9200T, Omron Healthcare or TM2656, A&D). The mean of the 2nd and 3rd readings was averaged for analysis. Hypertension was defined as a BP of at least 140 mmHg systolic or 90 mmHg diastolic, or the use of antihypertensive medication. Controlled BP was defined as a BP below 140 mmHg systolic and 90 mmHg diastolic in treated hypertensive patients. Trained volunteer investigators administered a questionnaire via a Wechat quick response code to

collect information on lifestyle, medical history, and use of medications. Body height, body weight, and waist and hip circumferences for each participant were measured. Body mass index (BMI) was calculated as the body weight in kilograms divided by the body height in metres squared. Overweight and obesity were defined as a BMI of 25.0–29.9 and  $\geq 30.0$  kg/m<sup>2</sup>, respectively.

Data were analysed centrally by the MMM project team and multiple imputations performed to impute the mean of the 2nd and 3rd readings where this was missing, based on the global data. All statistical analysis methods were described in detail previously.<sup>4</sup>

## Results

The 238 387 participants included 127 853 women (53.6%) and had a mean ( $\pm$ SD) age of  $48.9 \pm 16.2$  years, and a mean BMI of  $23.5 \pm 3.2$  kg/m<sup>2</sup>. In total, 57 848 (24.3%) were overweight and 7372 (3.1%) obese. A total of 179 231 (75.2%) reported that they had no BP measurement taken in the previous year. In total, 32 034 (13.4%) were on antihypertensive medication. Of the 32 030 persons with a recorded number of antihypertensive medication classes, 63.9% were taking a single medication, and 36.1% were taking  $\geq 2$  medications. In total, 9035 (3.8%) were taking aspirin and 7136 (3.0%) on statins. Of all participants, 12 154 (5.1%) self-reported having diabetes mellitus, 12 948 (5.4%) a history of myocardial infarction, and 6493 (2.7%) a history of stroke, and 16 906 (7.1%) were current smokers, and 18 050 (7.6%) reported drinking alcohol one to three times per month (4.6%), and once or more per week (3.0%). Among women, 1125 (0.9%) were pregnant at the time of screening, and 109 (0.1%) reported a history of hypertension in a previous pregnancy. The majority of screening took place in hospitals or clinics (78.7%), with 17.1% in outdoor public areas and 4.0% in other settings. In total, 197 521 (82.9%) participants were screened on weekdays and 40 866 (17.1%) on weekends.

In the 234 258 participants with all three individual BP readings, the mean systolic/diastolic BP decreased from 123.9/75.1 mmHg for the first reading to 122.2/74.0 mmHg for the 2nd and 121.1/73.3 mmHg for the 3rd, with a corresponding decrease of the prevalence of hypertension from 31.4% to 29.1% to 27.8%. After multiple imputations, of all 238 387 participants, the proportion with hypertension was 27.8% ( $n = 66 181$ ). Of those with hypertension, 51.5% were aware of their diagnosis, and 48.4% were on antihypertensive medication. Of the 32 034 participants on medication, 60.2% had BP controlled to  $< 140/90$  mmHg. Of all hypertensive participants, 29.1% were controlled to  $< 140/90$  mmHg (Table 1).

**Table 1** Total participants and proportions with hypertension, awareness, on medication and with controlled blood pressure

Total participants	Number (%) with hypertension	Number (%) of hypertensive patients aware	Number (%) of hypertensive patients on medication	Number (%) of those on medication with controlled blood pressure	Number (%) of all hypertensive patients with controlled blood pressure
238 387	66 181 (27.8)	34 059 (51.5)	32 034 (48.4)	19 283 (60.2)	19 283 (29.1)

Linear regression models showed differences in systolic and diastolic BP according to sex, age, previous stroke, myocardial infarction, and diabetes mellitus, antihypertensive medication use and known hypertension, previous hypertension in pregnancy and current pregnancy, alcohol intake and current smoking, and BMI ([Supplementary material online, Figures S1-S6](#)).

## Discussion

Our opportunistic screening showed that the proportion of hypertension among these Chinese adults screened was 27.8%, and the awareness, treatment, and control rates were 51.5%, 48.4%, and 29.1%, respectively. These observations were similar to the results of MMM 2017<sup>1</sup> and 2018<sup>2</sup> in China and showed a slightly and gradually improved management of hypertension in China in the past several years.

The present study and the data obtained in the years of 2017<sup>1</sup> and 2018<sup>2</sup> repeatedly and consistently showed that BP was higher in those who were overweight or obese compared with those of a healthy weight. This observation needs to be further investigated, with regard to its ecological implications between provinces to better understand contribution of obesity to the prevalence of hypertension in China.

The MMM 2019 project included more measurement sites outside clinics/hospitals than in previous campaigns. Indeed, there were measurement sites in public places, workplaces, and pharmacies. This expansion in measurement sites involved a newly established BP measurement system, which was web-based and Wechat-linked and allowed automatic transmission of BP readings to a central database for analysis and feedback.<sup>5</sup> The system is in its expansion and hopefully providing an ease-of-reach platform for BP measurement in the community.

In conclusion, the MMM 2019 has been successful in measuring BP in a large member of participants from communities in almost all provinces in China. With time, the project will help achieve the recently defined goal to improve the control rate of hypertension to 50% in China by 2030.<sup>5</sup>

## Supplementary material

[Supplementary material](#) is available at *European Heart Journal Supplements* online.

## Acknowledgements

The authors gratefully acknowledge the voluntary participation of the study participants and investigators. Omron Healthcare (Kyoto, Japan) donated BP measuring devices and provided logistics support via Shanghai ZhiZhong Technology (Shanghai, China). Shanghai Hesi Technology also provided BP measuring devices.

## Funding

J.-G.W. was financially supported by grants from the National Natural Science Foundation of China (91639203 and 82070435), Beijing, and the Shanghai Commission of Science and Technology (19DZ2340200), Shanghai, China.

## Data availability statement

All data are confidential in nature and may only be provided with permission of authorities.

**Conflict of interest:** J.-G.W. reports having received lecture and consulting fees from Novartis, Omron, and Servier. The other authors declared no conflict of interest.

## References

- Chen X, Xu SK, Guo QH, Hu Z, Wang HY, Yu J, Li WH, Tang GB, Zhang HF, Li Y, Wang JG. Barriers to blood pressure control in China in a large opportunistic screening. *J Clin Hypertens (Greenwich)* 2020;**22**: 835-841.
- Chen X, Li Y, Hu Z, Liu M, Yu J, Wang HY, Xu LY, Zhou BR, Yu W, Li L, Tang GB, Beaney T, Ster AC, Poulter NR, Wang JG. May Measurement Month 2018: an analysis of blood pressure screening results from China. *Eur Heart J Suppl* 2020;**22**:H40-H42.
- Wang Z, Chen Z, Zhang L, Wang X, Hao G, Zhang Z, Shao L, Tian Y, Dong Y, Zheng C, Wang J, Zhu M, Weintraub WS, Gao R, On behalf of the China Hypertension Survey Investigators. Status of hypertension in China: results from the China Hypertension Survey, 2012-2015. *Circulation* 2018;**137**:2344-2356.
- Beaney T, Schutte AE, Stergiou GS, Borghi C, Burger D, Charchar F, Cro S, Diaz A, Damasceno A, Espeche W, Jose AP, Khan N, Kokubo Y, Maheshwari A, Marin MJ, More A, Neupane D, Nilsson P, Patil M, Prabhakaran D, Ramirez A, Rodriguez P, Schlaich M, Stekelings UM, Tomaszewski M, Unger T, Wainford R, Wang J, Williams B, Poulter NR, MMM Investigators. May Measurement Month 2019: the global blood pressure screening campaign of the International Society of Hypertension. *Hypertension* 2020;**76**:333-341.
- Wang JG. Unique approaches to hypertension control in China. *Ann Transl Med* 2018;**6**:296-296.